APPLICATION OF EPA'S BASINS MODEL FOR A WATERSHED ASSESSMENT PROJECT IN FULTON COUNTY, GEORGIA

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Abstract. This paper briefly outlines the components of EPA's BASINS Model along with its application to the Camp Creek and Little River Watershed Assessment Project located in Fulton County, Georgia. A brief overview of the project objectives is presented along with other primary tasks associated with watershed assessment, (i.e., characterization, modeling, watershed management, and public involvement).

INTRODUCTION

Urban growth and development can adversely affect the water quality and biotic integrity of streams. Understanding the sources and magnitudes of stream impairment is crucial to developing effective protection strategies for achieving water quality improvements and restoring or maintaining biotic integrity.

Fulton County has undertaken a Watershed Assessment and Modeling Study to evaluate water quality in all major stream systems in the County as it relates to land use and point and nonpoint source pollutant loadings.

The watershed assessment approach is a fair and cost-effective method that communities nationwide are using to efficiently and effectively improve water quality. Current point and nonpoint pollutant sources are inventoried, and the most cost-effective improvement plan for future conditions is developed based on the relevant pollutant sources.

The watershed assessment program has four major elements: characterization; modeling; watershed management; and public involvement.

FULTON COUNTY WATERSHED ASSESSMENT PROJECT OBJECTIVES

The objectives of Fulton County's Watershed Assessment Project are to:

- Assess the current status of Fulton County streams with respect to water quality standards and biotic integrity, and identify primary causes of stream impairment;
- Develop focused, user-friendly watershed models to predict pollutant loadings and impacts from both nonpoint and point sources under various scenarios of land use development and watershed controls;
- Evaluate and develop realistic, flexible watershed management control strategies that can be successfully implemented to restore or maintain water quality standards into the future; and
- Involve and educate the public and stakeholder groups as to the reasons for and benefits of the project in developing efficient watershed management strategies that satisfy regulatory requirements.

CAMP CREEK AND LITTLE RIVER WATERSHED CHARACTERISTICS

Fulton County streams drain into one of three major river basins, or watersheds: the Chattahoochee River basin to the west; the Flint River basin to the southeast; and the Coosa River Basin to the northwest.

The Camp Creek Service area includes Camp and Deep Creek watersheds in the Chattahoochee River basin and Whitewater and Morning Creek watersheds in the Flint River basin. The Camp Creek watershed empties into the Chattahoochee River just downstream of the Utoy Creek watershed and is about 50 square miles in area. The Deep Creek watershed also empties into the Chattahoochee River and drains portions of Union City and Fairburn and is about 30 square miles in area. Both the Morning and Whitewater Creek watersheds are located southeast of Atlanta and drain to the Flint River Basin. Within Fulton County, the Morning and White Water Creek watersheds are about 25 and 5 square miles, respectively.

The Little River service area includes the Rocky Creek watershed. The Rocky Creek watershed is about 8 square miles in area, and enters Little River south of Cooper Sandy and Chicken Creeks. The Little River, with a total watershed area of 74 square miles, eventually flows into Lake Allatoona and is part of the Coosa River Basin.

The four major elements of the watershed assessment are described in the following sections.

CHARACTERIZATION

Existing data on Fulton County watershed characteristics were gathered from various local, State, and Federal sources. This information was used in the selection of water quality and biological monitoring stations, characterization of existing stream conditions in the watersheds, identification of primary causes of water quality and habitat impairment, and development of input parameters for the watershed modeling effort. The final assignment under this task is to prepare an Impacts Assessment Report, which:

- Documents the location, history, physical characteristics, land use, pollutant sources, and general water quality conditions of the watershed;
- Presents modeled results of pollutant loadings in the watershed under current conditions;
- Summarizes and compares the current water quality conditions reported in existing water quality data, and evaluates attainment of water quality standards;
- Summarizes the findings of the habitat and biological studies; and
- Investigates potential relationships between existing pollutant loading and biological ratings to determine loading guidelines that could be used to improve the ability of the rivers within these basins to meet designated uses.

MODELING

The first and perhaps the most important step in any modeling project is to clearly define modeling objectives at the outset. Development of the appropriate modeling approach and selection of modeling tools must be closely linked to project objectives.

Some of the major objectives identified for the Fulton County watershed modeling include: 1) representation of the present water quality conditions; 2) quantification of pollutant loads and sources; 3) assessment of water quality response to management alternatives and 4) prediction of water quality response to future land use changes.

Model selection proceeded from the identification of objectives and began with a review of available models. We used US EPA's 1997 "Compendium" (EPA, 1997) of models as a starting point for model selection. A structured approach was developed interactively with the County to ensure that the process meets the project needs.

Eight candidate models were reviewed based on the modeling objectives. Other factors considered for model selection included consistency in model usage by various counties in the metropolitan Atlanta area and the general recommendations of the US EPA for watershed modeling. Based on this analysis, the BASINS 2.0 (Better Assessment Science Integrating Point and Nonpoint Sources) (EPA, 1998) was selected, as it wholly or partially satisfied all the modeling objectives.

The BASINS is a multipurpose environmental analysis computer model for use by regional, state, and local agencies in performing watershed and water quality based studies. The BASINS 2.0 package includes: 1) national databases; 2) assessment and targeting tools to evaluate water quality at various scales; 3) package programs to import local data such as land use, digital elevations, and soils; 4) tools for watershed delineation; 5) a suite of water quality models, including HSPF, QUAL2E, and TOXITROUTE; and 6) graphical post-processing of simulated data. The integrated ARCView GIS format of BASINS provides a platform for ready manipulation of land use information, while the incorporated HSPF model allows simulation of a range of parameters at a variety of time scales, from hourly to seasonal.

WATERSHED MANAGEMENT

The purpose of the Watershed Management Plan is to develop a realistic, implementable framework for watershed management, including combinations of watershed controls, best management practices (BMPs), and land use guidelines.

PUBLIC INVOLVEMENT

The public involvement program is an integral part of the project that is used to foster interest in the project and to begin establishing long-term support for the future implementation of expanded land use and non-point source management practices to meet water quality compliance requirements. Public participation, public education, and public relations are complementary and necessary components of the public involvement program that will be used throughout the project in order to meet the County's project objectives.

APPLICATION OF BASINS MODEL

The BASINS model application to the Camp Creek and Little River Watersheds follows these general steps:

1) Sub-basin delineation to determine the number of individual model applications that will be required.

2) Model calibration to fine-tune the model's predictive ability and model validation to verify the model's predictive ability.

3) Model application to determine pollutant loadings in the

watershed for current conditions.
4) Model simulations to evaluate various watershed management scenarios

Successful application of the BASINS 2.0 model requires development of a modeling approach, also referred to as a "simulation plan." The plan describes the development of data sets for meteorology, land use, and point source data. It also includes: 1) watershed segmentation; 2) channel segmentation, and 3) simulation period and parameters. The following sections briefly discuss these aspects of the simulation plan developed for the Camp Creek and Little River watersheds.

Meteorologic and Precipitation Data

The meteorologic database development was limited to the period of 1996-1998 to accurately represent the current land use practices within the watershed. To ensure accuracy of meteorological data, a data search to locate meteorological stations within the Camp Creek and Little River watersheds was conducted. The necessary data was either obtained from the National Climatic Data Center (NCDC) or from the local meteorological stations. The data was then formatted for input into the Watershed Data Management (WDM) file used by the BASINS model.

Land Use Data

The land use information was obtained from the Atlanta Regional Commission's (ARC's) Economic Development Information System CDROM. The data set was originally created from a 1975 digital land use/cover database compiled by the U.S. Geological Survey (USGS). The coverage was then updated using satellite imagery and low-altitude aerial photography in 1990 and updated again in 1995 using low-altitude aerial photography.

Point Source Data

Point source data represent all loadings from municipal and industrial wastewater treatment plants that discharge to the channel reaches in the basins. Actual reported flow and effluent data was input in the BASINS model. US EPA's Permit Compliance System database was used to identify the point source dischargers within the Camp Creek and Little River watersheds.

Watershed Segmentation

The watershed was delineated so as to divide the study area into individual land segments that are assumed to produce a homogeneous hydrologic and water quality response. This segmentation allows the user to assign identical model parameter values to all parts of the watershed that produce the same unit response of runoff and chemical constituents for a uniform set of meteorologic conditions.

For the Camp Creek and Little River watersheds, watershed segmentation was based on the location of water quality monitoring sites, which were selected under the Watershed Characterization Task.

In the BASINS model, the land use practices are simulated using the Pervious Land Use Segment Module (PERLNDS) or the Impervious Land Use Segment Module (IMPLNDS). The difference between the PERLND and IMPLND modules is that the infiltration process is simulated only for the PERLND segments and not for the IMPLND segments. A maximum of 12 PERLNDS and 12 IMPLNDS are simulated; however, these segments differ within each subwatershed based on their current land use practice.

Channel Segmentation

The Camp Creek and Little River stream channel and its tributaries are the major pathways that transport pollutants from the watershed. As such, it is important to accurately represent or characterize the channel network in the HSPF model of the watershed. Characterization of the channel network was based on measuring channel cross section data. The Biological and Water Quality Field Monitoring Technical Memorandums (CH2M HILL, 1998) served as guidelines for channel segmentation.

Individual channel reaches are represented in HSPF using FTABLEs (i.e., function tables). An FTABLE is a table of stage-volume-discharge information that allows HSPF to determine the amount of channel storage and the routing of streamflow through the channel reach system. In addition to stage (water depth) and discharge information, the FTABLE also includes surface storage area and the channel volumes. Stage, discharge, area, and volume information is required at 0.5 or 1.0 foot levels starting at the channel bottom and proceeding to the top of the bank.

Simulation Period and Associated Limitations

Once the databases were developed, the Camp Creek and Little River delineated watersheds with their associated land use channel characteristic data were imported into the BASINS model. These watersheds were then further delineated into subwatersheds based on the procedures described above. The simulation plan and available data base for applying BASINS 2.0 to the Fulton County Watershed Assessment Project are as follows:

Simulation Period

- Hydrology Calibration, 1996-1997
- Water Quality Calibration, 1996

Constituents Simulated

- Runoff (all components) and Streamflow
- Sediment Erosion/Delivery and Instream Suspended Sediment

- Water Temperature
- Dissolved Oxygen
- BOD
- Fecal Coliform
- Nitrogen (total, nitrate/nitrite, ammonia, organic)
- Phosphorus (total, phosphate, organic)
- Metals (copper, cadmium, zinc)

Initial input parameters for hydrology and water quality constituents for this application were obtained using the default data set provided with the BASINS model. Using this initial set of input parameters, the BASINS model is being applied to the Deep Creek pilot watershed due to the availability of historical flow and water quality data for calibration. The model parameters developed for the Deep Creek watershed will then be used as the initial parameters for the remaining watersheds. Additional streamflow and water quality data collected during the Watershed Characterization Task will then be used to further refine the model calibration results. After calibration of the current conditions, the BASINS model will be used to evaluate various scenarios so as to protect water quality in Fulton County streams.

SUMMARY

The paper briefly discussed the procedures for conducting a watershed assessment study, along with a methodology for applying the BASINS model to the Fulton County Watershed Assessment project.

Results from watershed assessment studies similar to the Fulton County study can be used for the development of Total Maximum Daily Loads, National Pollution Discharge Elimination System permit renewal, Evaluation of BMPs, Land Use Planning and Zoning, among others.

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